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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/016,255	12/10/2001	Peijun Ding	AMAT/2859.C1/CPI/COPPER/P	7901

32588 7590 02/06/2004

APPLIED MATERIALS, INC.  
2881 SCOTT BLVD. M/S 2061  
SANTA CLARA, CA 95050

EXAMINER
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MCDONALD, RODNEY GLENN

ART UNIT	PAPER NUMBER
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1753

DATE MAILED: 02/06/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/016,255

Applicant(s)

DING ET AL.

Examiner

Rodney G. McDonald

Art Unit

1753



-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 10 November 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 6-23 and 25-30 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 6-23 and 26 is/are allowed.
- 6) ☒ Claim(s) 25 and 27-30 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. §§ 119 and 120**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
- a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

**DETAILED ACTION**

***Claim Rejections - 35 USC § 112***

Claim 25 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 25 is indefinite because it depends from cancelled claim 24.

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 27, 29 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hoinkis (U.S. Pat. 6,146,517) in view of Venkatraman et al. (U.S. Pat. 6,093,966).

Hoinkis teach filling trenches with copper. (See Abstract) The liner be selected from the following five choices: CVD TiN; CVD TiN/PVD Ta; PVD Ta/CVD TiN/PVD Ta; PVD TaN/PVD Ta and PVD Ta. (Column 3 lines 11-15) Better results were obtained if there was also included by ionized physical vapor deposition (I-PVD) a tantalum rich film. Best results were obtained when there was first deposited a I-PVD Ta-rich film, followed in turn by **CVD TiN** and **I-PVD Ta-rich films**. (Column 3 lines 26-30) After the liner is formed one can proceed with copper filling. The copper filling sequence comprises **chemical vapor deposition of a copper seed layer, preferably proceeded by physical vapor deposition of a flash copper layer** to aid in nucleating the subsequent CVD copper seed layer. The filling is then completed by copper electroplating. (Column 3 lines 42-52)

The difference between Hoinkis and the present claims is utilizing a high density plasma physical vapor deposition process to deposit the copper seed layer is not discussed and utilizing a hollow cathode to deposit the second tantalum barrier layer is not discussed.

Lai et al. teach a high density plasma deposition process utilizing a hollow cathode magnetron. (See Abstract) The hollow cathode magnetron can deposit materials such as tantalum and copper. (Column 3 lines 8-11)

The motivation for utilizing a high density plasma deposition process utilizing a hollow cathode magnetron to deposit metals such as tantalum and copper is that it allows for achieving high ionization levels, good step coverage and good process uniformity. (See Abstract)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Hoinkis by utilizing a high density plasma deposition process utilizing a hollow cathode magnetron to deposit metals such as tantalum and copper as taught by Lai et al. because it allows for achieving high ionization levels, good step coverage and good process uniformity.

Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hoinkis in view of Lai et al. as applied to claims 27, 29 and 30 above, and further in view of Ngan et al. (EP 0 867 525).

The difference not yet discussed is the use of an integrated system platform.

Ngan et al. teach an integrated system for forming linear layers and metallization on a substrate. (Column 6 lines 55-58; Column 7 lines 1-15)

The motivation for utilizing an integrated processing system is that it allows for depositing layers on a substrate. (Column 6 lines 55-58; Column 7 lines 1-15)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized an integrated system platform as taught by Ngan et al. because it allows for depositing layers on a substrate.

#### ***Allowable Subject Matter***

Claims 6-23 and 26 are allowed.

Claim 25 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, second paragraph, set forth in this Office action.

The following is a statement of reasons for the indication of allowable subject matter:

Claims 6-23 are indicated as being allowable over the prior art of record because the prior art of record does not teach forming the first and second barrier layers as claimed where the first and second barrier layers form a high conductance barrier layer having a resistivity of less than about  $160\ \mu\Omega\text{-cm}$ .

### ***Response to Arguments***

Applicant's arguments filed 11-10-03 have been fully considered.

Applicant's arguments with respect to claims 6-23, 25 and 26 are deemed persuasive. Remaining newly added claims 27-30 have been rejected as discussed above. It is believed that the cited art teaches Applicant's required claim limitations.

### ***Conclusion***

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rodney G. McDonald whose telephone number is 571-272-1340. The examiner can normally be reached on M- Th with Every other Friday off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam X. Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 571-272-1300.

A handwritten signature in black ink, appearing to read "Rodney G. McDonald", is written in a cursive style.

Rodney G. McDonald  
Primary Examiner  
Art Unit 1753

RM  
January 30, 2004